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THE AUTOMATIC MACHINE 'EFTRONIK'S' ELECTRONIC SYSTEM'S STATIONS--ETC(U)
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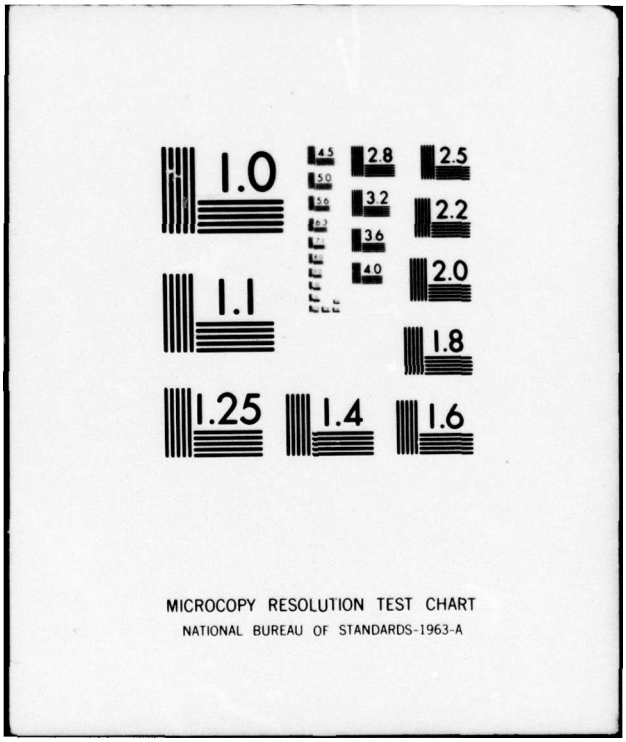
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FOREIGN TECHNOLOGY DIVISION

THE AUTOMATIC MACHINE "EFTRONIK'S" ELECTRONIC SYSTEM'S STATIONS RE-ADJUSTED FOR JOINT OPERATION WITH COMPUTERS

by

J. Rychlewski

EDITED TRANSLATION

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THE AUTOMATIC MACHINE "EFTRONIK'S" ELECTRONIC SYSTEM'S STATIONS RE-ADJUSTED FOR JOINT OPERATION WITH COMPUTERS

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THE AUTOMATIC MACHINE "EFTRONIK'S" ELECTRONIC SYSTEM'S STATIONS RE-ADJUSTED FOR JOINT OPERATION WITH COMPUTERS

The Industrial Automatic Machine Company "Mera-Pnefal" exploiting exploiting technical help from abroad is beginning production of the electronic system of the analogue automatic machine EFTRONIK which is the equivalent of the HONEYWELL firms VUTRONIK electronic system.

The EFTRONIK system is distinguished by the possibility of joint operation with computers of various types. This joint operation is made possible by machines

- of direct control, i.e., DDC
- of higher order control, i.e., DSC

In stations of the DDC type the computer's controlling input signals get modified into exit signals which react with effector organs; instead in stations of type DSC they determine an imposed value of the regulating circuit.

In the bulletin below there are presented two types of higher order control stations: model 36717 and model 36717.

The controlling signals are usually different depending on the type of computer applied. For this reason we speak of adaptation of the station for joint operation with the computer of a particular firm. Computer stations of the EFTRONIK system operate jointly with the computers of HONEYWELL, IBM, FERRANTI, AEI-ELLIOT, and the GE 4020. The possibility of this joint operation is determined by a computer interface or a module pack for control of a computerized direct or higher order "Computer" station.

Higher Order Control Station (DCS) Model 36787

It is designed for work as a PI or PID regulator, in automatic regulation circuits. The selection of the type of operation is accomplished by hand with a selection switch which is located on the front plate of the panel (Figure 1). In the position M the output signal from the station is proportional to the value of the voltage on the hand control storage condenser. The value of this voltage can be fixed established) by pushbuttons that are located on the front plate of the panel. In position B read-off is possible of the imposed value that has been determined by the computer whereupon the output signal of the station is such as in position M. In position A the station operates as a PI or PID regulator (the selection of the function is accomplished with the help of handwheels on the regulator's module-pack) with an imposed value established by hand on an internal potentiometer for the imposed value. In the type-of-operation selector switch's position S there emmerge two types of operation: control with computer and local control.

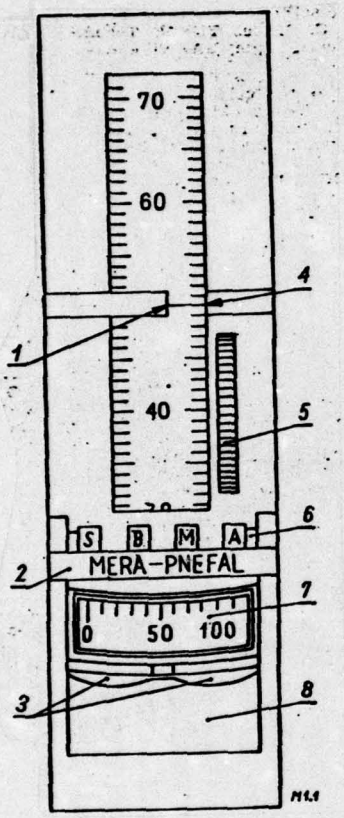

Figure 1. Higher order control station front plate-model 36787 (callouts): 1 - Indicator of the value of the measure quantity (regulated); 2 - handle of the panel; 3 - manual control buttons; 4 - imposed value; 5 - manual setting for the imposed value; 6 - type-of-operation selector switch; 7 - indicator of the output signal; 8 - signal lamps.

Computer Control

The control signal which is a current pulse with variable polarity, with a time of duration of 2 ms and of a value 0.05-5 mA is applied thru a gate to the memory (storage) system. The 5 mA signal changes the imposed value in a range of 10% (Figure 2). A limiting system does not permit crossing the lower value of the voltage 1 V by more than 0.5 V and the upper 5 V by no more than 1 V. The voltage of the value from the computer relative to the signal-ground must amount to 1-5 V.

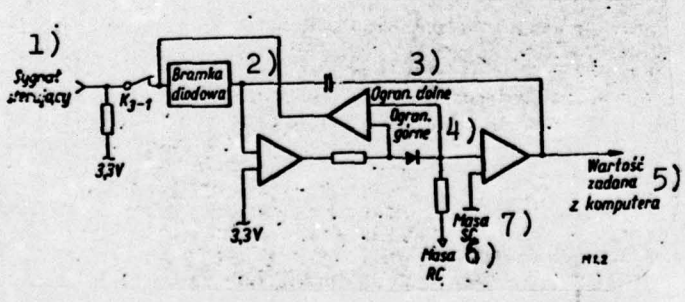

Figure 2. Block diagram of the higher order control module (callouts): Key: (1) Control signal; (2) diode gate; (3) lower organ; (4) upper organ; (5) imposed value from the computer; (6) signal ground; (7) DC ground.

Local Control

Besides the control signal the station gets from the computer information about the operation of the on-line system. If the

computer does not hold the station with its operation (for instance realizes a program of higher priority) on the bus of the signal for detaching the computer (breakdown), there appears the voltage OV (short circuit signal). During on-line operation this signal is an open contact (Figure 3). The appearance of the voltage OV as of the signal of disconnecting of the computer, turns on the relay K_3. This causes suitable changes of the electrical systems on the higher order control module pack and as well as a transfer (switch-over) to the signal regulator module pack of the value imposed determined by the last signal from the computer or thru the voltage value on the internal potentiometer of the value imposed (just such as for position A). The operation of the relay K_3 similarly causes an opening of the connections of the control signal system with the memory (storage) system.

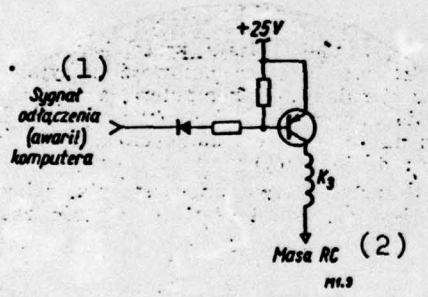

Figure 3. Plan if the input system of the disconnect-computer (break-down) signal (callouts.)
Key: (1) Disconnect computer signal (breakdown); (2) signal ground.

Equally during local control as during control from the computer the higher order control station operates in positions as a PI or PID regulator. From the description presented in Figure 4 it follows that the station has two types of outputs: 4-20 mA and 1-5 V. It is stressed that both outputs can be used simultaneously. Figure 5 presents the last amplification stage of the module pack of the regulator. It is necessary to mark that exploiting exclusively the voltage output requires short-circuitings of the leads (+) and (-) of the current output.

Besides the already mentioned ones, two more signals connect the station with the computer: the type of operation signal and the feedback. The type of operation signal (realized by a two conductor connection, insulated) is a short circuited contact

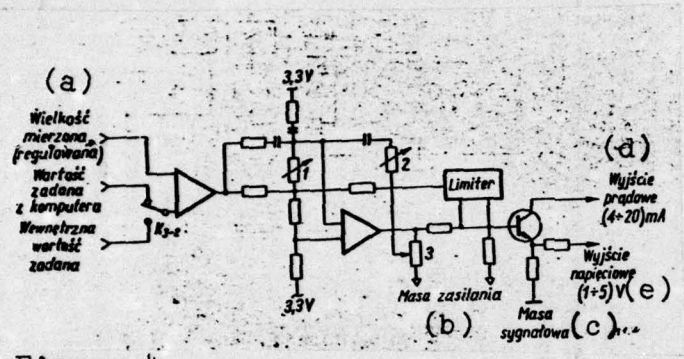

Figure 4.

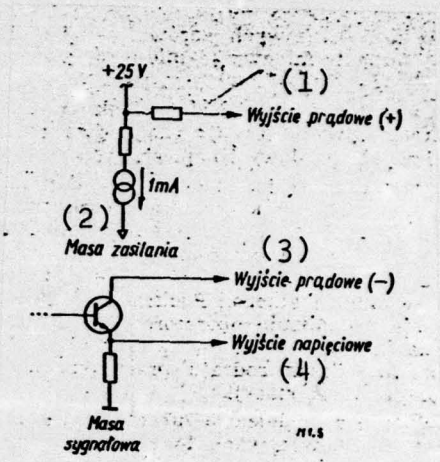

Figure 5.

Figure 4. Block diagram of the regulator module: 1 - time of doubling selector switch; 2 - lead time selector switch; 3 - proportionality range potentiometer. (Callouts).
Key: (a) Measure magnitude (regulated); value imposed from the computer, internal imposed value; (b) supply (DC) ground; (c) signal ground; (d) current output; (e) voltage output.

Figure 5. Output level of the panel (callouts).
Key: (a) Current output; (b) supply ground; (c) current output; (d) voltage output; (e) signal ground.

only for position S of the type-of-operation selector switch (independent of th lack or existance of a disconnect-of-the computer signal). In the remaining position it is an open contact.

The feedback signal is in higher order control stations, information about the imposed value. This information in the station model 36787 is sent thru in the form of the value of the voltage of the imposed value that is 1-5 V. In position A this is the voltage form the internal potentiometer of the imposed value. In position S during control from the computer this is a voltage that is being taken from the memory (storage) system of the higher order control module pack, but in case the computer is disconnected from the imposed values internal potentiometer. It is necessary to stress that when the computer is disconnected the voltage in the memory system rises (or falls) to the level of the value of the

voltage on the imposed value's internal potentiometer. In the remaining positions the feedback signal is the same as in position A.

Of the two little signal lamps one (the right hand one) is connected with the operation of the station. It is turned off only in selector switch position S during the simultaneous lack of a computer disconnection signal. The other little lamp has an external lead and can be used for signalling of a selected parameter in accordance with the planner's assumption.

FIRST LINE OF TITLE

The characteristic feature of the higher order control station model 36787 is its great flexability in operation with a computer. Disconnection of the computer and appearance of the signal: computer out (breakdown) can from time to time be treated as a remote order for the obtaining of a stable level of the imposed value. Renewed hooking back up of the computer can be at all times reestablished without any sort of troubles.

A second distinguishing feature is single lead control. Between the computer interface block and the station there are no address lead. The station model 36787 belongs to a group of unaddressed devices and is adapted for joint operation with the GE 4020 computer.

Higher Order Control Station (DSC) Model 36717

In regard to the joint operation of the station with a computer there is introduced/(ing) a partition into non-addressed stations and addressed stations. Address stations are adapted to direct joint operation with computers: HONEYWELL, IBM, FERRANTI, or AIE ELLIOT. To them there belongs model 36717. A higher order control station is designed basically for work as a PI

STOP HERE STOP HERE

or a PID regulator in automatic regulation systems. At position M the station makes it possible to carry on manual control which depends on an increase or decrease of the output sign by levels by the medium of pushbuttons that are located on the front. In position A the station operates as a regulator with an imposed value determined by the value of the voltage on the imposed internal potentiometer. In the type-of-operation selector switch's values/the station is connected with a computer which determines the current imposed value thru the medium of a control signal. The controlling signal is a position signal 1-5 V with an input impedance greater than 250 kΩ and an impedance of the source of 250 Ω. In order that this signal should be accepted thru the station there is required also required the existance of a signal from the address system, which causes the establishment of the internal potentiometer's imposed value (thru a servomotor) in the position required by the computer. There are sent through the station through the medium of two address leads pulse signals which cause the starting of several functional circuits placed on the higher order control module pack. These pulses, depending on the type of computer are of twofold type: voltage and short-circuit. The logical levels are as follows:

- for a voltage type

  logical "0"=30-+1.5 V, imput impedance 10MΩ

  logical "1"=4-30 V, imput impedance 100 MΩ

- for a short circuit type

  logical "0" opening of the input circuit of the address gate

  logical "1" short circuit of the gate circuit.

As an example for the short circuit type the input system for address signals is presented on Figure 6. The minimum time of duration of the address signals amounts to 3 ms. The signal

from the address system starts the pulse generator. The time of duration of this pulse (of amplitude 25 V) amounts to 7.5 s. This signal controls the servomotor's amplifier which adjusts the imposed value to that magnitude required by the computer, during which it is possible to change it (magnitude) at most by 40% of its range, during these 7.5 s.

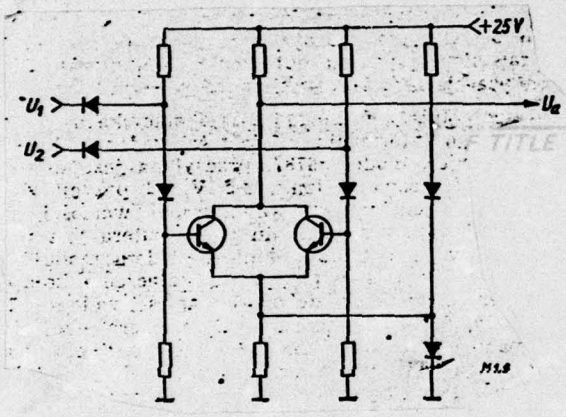

Figure 6. Input system of the short-circuiting address signals U_1; U_2 short circuiting address signals U signal from address system.

The control system memorized in an amplifier with a short term memory is being compared with the upper and lower settings of the signalling system and given to the servomotor's amplifier in the system as in Figure 7. In case of crossing through the imposed value given by the computer by the upper or lower signalling level, that is output above the established range of changes or in case of the giving of a disconnect the computer (breakdown) signal, relay K_1 goes into action (this is a transition state to local control) which will cause the switching in of a signalling lamp, which signals a state of alarm and the opening of the contacts of the type-of-operation signal. Simultaneously a signal is given to the pulse generator system suppressing its action. Figure 8 presents the block diagram.

After transition to local control the computer cannot interfere with the operation of the station. After "removal" of the reason for transition to local control immediately after the operator's intervention, which is based on adjusting the type-of-operation selector switch to any other arbitrary position

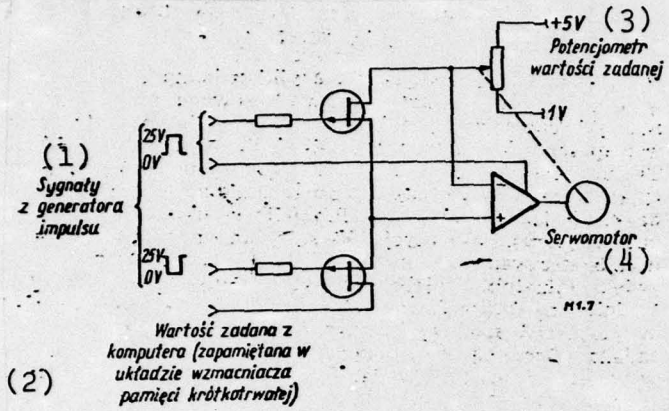

Figure 7. Block diagram of the establishment of the imposed value (callouts). Keys: (1) Signals from the pulse generator; (2) value imposed from the computer (memorized in the memory of the amplifier with the short term memory); (3) imposed value potentiometer; (4) servomotor.

and back to positions control from the computer can be renewed. During compulsory transition to local control the station remembers the conditions of operation just before, that is such as existed before the sudden existance of the cause for the transition to local control. The imposed value established by the computer can however be changed by the operator through the medium of the hand wheel that is found on the front of the panel.

The disconnect (breakdown) signal of the computer is the state of the contact system for ordinary operation (computer coupled to the station) the contact is shorted to ground and the impedance of the source is $\leq$ 250 Ω. In a state of "machine breakdown" the contact is open-circuited and the input impedance is $\geq$ 1 MΩ.

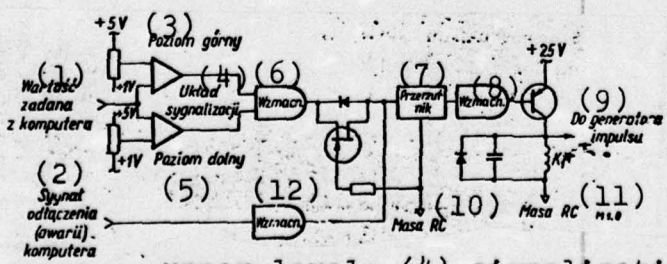

Figure 8. Alarm system signalization system (callout). Key: (1) Value imposed from the computer; (2) computer disconnecting signal (breakdown); (3) upper level; (4) signalization system; (5) lower l level; (6) amplifier; (7) flip-flop; (8) amplifier; (9) to the pulse generator; (10) signal ground; (1) amplifier.

Similarly the type-of-operation signal is the signal of a contact system whose short-circuiting signifies the station's readiness to accept control signals from the computer, and its open-circuiting signfies a disconnecting of the control from the computer (that can be the effect of transition to local control or of positions M or A of the type-of-operation selector switch).

In the feedback loop between the station and the computer there is produced a signal that determines the imposed value (a voltage from the slider of the potentiometer 1-5 V) in the presence of an output impedance $\leq$ 2 kΩ and permissable local impedance $\geq$ 3 MΩ. Depending on the type of computer this signal is gated by a signal from the system that joins gathers the address signals.

The inaccuracy of the imposed value of the threshold of operation of the signalling, and of the feedback signal, amounts to ± 0.5%

The error of the time signals, both the short period (8 hours an the long one (6 months) in less than ± 0.2%.

The regulator module is analogous to that (analogue like that?) in station 36787; there can also be used two types of output signals: current and voltage.

A characteristic feature of the station is the bringing to it from the computer interface block of two address leads from which there are given pulse signals that determine the joint operation with the computer (they increase safety). Another feature is the impossibility of removing by the computer of a state of local control. It requires stressing however that the computer does not signal to the operator the removal of the reason for the transition to that control, the operator can only, manipulating the type-of-operation selector switch, confirm the on-line connection of the computer with the station.

In comparison with model 36787 it appears to be of one memory system less. This was caused by the bringing into realization on the imposed value's internal potentiometer both a memory of position A as well as (thanks to a servomotor) for position S.

In the description of stations that operate jointly with a computer, special attention is devoted to signals that assure and condition this joint operation. Dispersing information about these signals makes possible investigation of the possibilities of joining arbitrary computer systems with stations that assure controlling a technological process.

In the EFTRONIK system, as a measured value (regulated) there can appear the following signals: 4-20 mA, 10-50 mA, 1-5 mA, and 1-5 V. Modification of the first three current signals to a standard voltage signal 1-5 V within the framework of the station is accomplish by the insertion between the input terminals of an adjustable resistor-respectively 250 Ω, 100 Ω, and 1 kΩ. The output signal from the station can be a current signal 4-20 mA, with a maximum resistance of the output circuit of 590 Ω or (can be) a voltage signal 1-5 V. The apparatus which operates jointly with the station must have a minimum resistance of the input circuit of 250 kΩ. Both signals can be applied simultaneously. There are applied besides this two output systems: a standard system and a system with a common zero bus. This last is applied in the modification of a spark-safe system. As a regulator the system has the following parameters: amplification:

amplification:
(Established in a continuous manner)
from 1 to 100
or from 0.1 to 10,
integration; time of doubling (stepwise)
.01 to 5 min
or 0.1 to 50 min

differentiation: lead time (stepwise)
0.02 to 10 min

Supply: 25 volts of DC current at a rated 23.5 to 25.5 V and a max pulsation (ripple) between the peaks of 100 mV.

Ambient temperature: 5-50° C with a relative humidity of 10-90%.

Accuracy: (reliability) of the indications

of the measured magnitude	0.5%
of the imposed magnitude	0.5%
of the error of the regulation	0.6%

There imparts technical information:

Przedsiebiorstwo Automatyki Przemyslowej „Mera-Pnefal",
ul. Poezji (Poetry Street) 19, 04-994 Warszawa (Warsawa)
Telephone 12-90-01.

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